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Case-Based Reasoning System Applied as an Advisor for IVF Practitioners

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Objectives: The aim of IVF is the highest success rate. There are many factors involved. Even though there is a great deal of unpredictable results, a computer model based on past experiences (a case-based reasoning system) can in some situations suggest possible treatment to improve the success rate. Once the information base is populated with sufficient amount of past cases, the same system can be used as an intelligent tool for finding possible relationships among data (knowledge mining).

Design: Randomly retrieved cases from IVF information base have been supplied as input to the $\mathcal{TA}\mathbf{3}_{IVF}$ system. System's response was compared to physician's judgment and to actual cases whenever available.

Materials and Methods: A case-based reasoning system was used to retrieve cases (already solved and stored in a case base) which are similar to the present case, adapt the most similar one to current situation and generate an advice. The case base currently consists of 788 cases of which 149 are clinically successful pregnancies, 10 are pregnancies with OHSS complication, 12 are pregnancies with abortion, 4 are pregnancies with ectopic and 632 are non pregnancies (there is not information about pregnancy on 7 cases). Every case is described by a set of 55 attribute-value pairs. The advice process is broken in to two steps: First, 8 attributes are known and the system predicts values for remaining attributes and Second, 39 attributes are known and

the system predicts remaining set. Retrieval of the closest past cases is based on context-based similarity measure. For adaptation phase, successful past cases are preferred and are used as a positive experience while unsuccessful pregnancies and pregnancies with complications are used as negative cases - as a warning.

Results: To evaluate the system's performance we used 10-way simple cross-validation. After selecting cases at random and submitting them to the system, the NO_HMG was predicted with relative error 0.15 ± 0.09 with 95% confidence and DAY_HCG was predicted with relative error 0.07 ± 0.04 with 95% confidence. Predicting pregnancy was achieved with more than 60% accuracy from initial 8 attributes and with more than 70% accuracy with E2 values available. Precision and recall are both 100% if submitted query is concerned. Both of them are, however, lower if we assume absolute knowledge about the patient. The reason is obvious – not all important aspects about the patients are available at the present knowledge base. Thus, two on the first look similar patients, have different IVF outcome. Obviously, something important, something discriminatory about them is not available to the system. Using of intelligent tools can help to shape the future knowledge bases so only relevant and all relevant information about patients will be collected.

Conclusions: Case-based reasoning is a proven technology. However, every domain poses individual constraints and problems and thus the performance of one system evaluated in one domain is not a guarantee for the same performance in another domain. The system can be used as an advisor to the physician during clinical work as well as during research, to help to find out which information is relevant for reasoning and to find all such an information.